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EXAMINER	
UMEZ ERONINI, LYNETTE T	
ART UNIT	**PAPER NUMBER**
1765	6

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Please find below and/or attached an Office communication concerning this application or proceeding.

AS-6

Offic Action Summary	Applicati n No. 10/045,318	Applicant(s) DEORNELLAS ET AL.	
	Examin r Lynette T. Umez-Eronini	Art Unit 1765	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondenc address* --

Period f r Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1 and 42-56 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1 and 42-56 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim R j ctions - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1, 51, 53, 55, and 56 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The steps of:

"oxidizing the hard mask in order to harden the hard mask" in **claim 1**;

"allowing the hard mask to react with etch process gases in order to harden the hard mask" in **claim 51**;

"allowing the hard mask to react with etch process gases in order to harden the hard mask, whereby the layer is etched corresponding to the pattern of the hard mask and the hardening of the hard mask holds the pattern of the hard mask being etched into the layer" in **claim 53**;

"allowing the hard mask to react with etch process gases forms a skin on the hard mask that is harder than the hard mask" in **claim 55**; and

"selecting a hard mask that will react with the etch process gases in order to harden the hard mask" in **claim 56**, are not supported by the Specification.

Claim Rejections - 35 USC § 102/103

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time th invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1 and 42-50 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Nulman et al. (US 4,496, 419).

As pertaining to **claim 1**, Nulman teaches a technique for fine line patterning having vertical walls of line widths (same as applicant's critical dimensions) much smaller than one micrometer (column 2, lines 1-3) for use in the fabrication of submicron devices (column 2, lines 8-11). The method comprises: covering a substrate (workpiece) **12** with an aluminum film **14,** oxidation mask **16,** and resist **18** (column 4, lines 8-13, 21-22); oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) that produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14** (column 5, lines 3-4); and when the Al (same as applicant's hard mask) film serves as an etch mask for the underlying substrate, transferring the

pattern to the substrate by means of any suitable dry etching process such as reactive ion etching (column 3, lines 18-23).

The above reads on, a method for etching a pattern on a workpiece, comprising:

selecting a workpiece with a hard mask deposited over a layer to be etched, which hard mask is comprised of a reactive metal, the hard mask further defining a pattern including at least one portion having a critical dimension; and

processing the workpiece in a reactor by exposing the entire hard mask to an etch.

Since Nulman uses the same method of oxidizing the same material (Al film) as that of the claimed invention, then using Nulman's method would inherently oxidize the hard mask in order to harden the hard mask.

Nulman differs in failing to explicitly teach whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of the layer during the etch is minimized in the portion of the layer corresponding to the critical dimension, in **claim 1**.

Since Nulman uses the same method and gases in processing a substrate (workpiece) in a reactor as that of the claimed invention, then it would be obvious to one having ordinary skill in the art at the time of the claimed invention that using Nulman's method of processing the workpiece in a reactor by exposing the entire hard mask to an etch would result whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of layer is minimized in the portion of the layer corresponding to the critical dimension.

The said above also reads on,

exposing the hard mask to a stream of oxidizing gas in the reactor prior to said etch step, in **claim 43**;

said selecting a step includes a selecting a workpiece with a lithographic layer covering the hard mask, in **claim 46**; and

said selecting step includes selecting a hard mask (1) on which has been or (2) on which can be developed at least one of an oxide, nitride fluoride, boride and carbide, in **claim 50**.

Nulman also teaches aluminum film **14** serves as an etch mask (column 19-20). Since Nulman uses the same Al etch mask, which is the same as applicant's hard mask, then using Nulman's Al film as an etch mask, reads on, said selecting step includes selecting a workpiece having a hard mask, which hard mask comprises of one of titanium, aluminum, and tantalum, in **claim 42**; a hard mask, which is readily oxidizable, in **claim 47**; and which is comprised of a metal with a low sputtering yield, in **claim 48**.

Nulman teaches:

Reactive ion etching the oxidized Al film (hard mask) by using BCl_2 (Note: BCl_3 (based on boron having a valence of 3) not BCl_2), (column 5, lines 29-31 and column 6, line 38-41), which is the same as applicant's oxidizing gas, reads on, exposing the hard mask to a stream of oxidizing gas in the reactor during said etch step, in **claim 44**; and

Exposing the hard mask to a stream of oxidizing gas in the reactor prior to or during said etch step (as stated above in the rejection of **claims 43 and 44** above) and

oxidizing the Al film by an O_2 plasma produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of Al film **14** (column 4, line 67 - column 5, line 5) and significantly reduces its etch rate (column 3, lines 6-7), reads on exposing the hard mask to a stream of oxidizing gas wherein the oxidizing stream comprises one of and any combination of oxygen, nitrogen, fluorine, boron, and carbon gas, in the reactor prior to or during said etch step in order to oxidize the surface of the hard mask and thereby slow down an etch rate of the hard mask, as in **claims 45 and 49**.

6. Claims 51-52 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Nulman ('419).

As pertaining to claim **51**, Nulman teaches a method for etching a pattern on a workpiece. The method comprises:

fine line patterning having vertical walls of line widths (same as applicant's critical dimensions) much smaller than one micrometer (column 2, lines 1-3) for use in the fabrication of submicron devices (column 2, lines 8-11);

covering a substrate (workpiece) **12** with an aluminum film **14,** oxidation mask **16,** and resist **18** (column 4, lines 8-13, 21-22);

oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14** (column 5; lines 3-5); and

when the Al (same as applicant's hard mask that comprises a reactive metal) film serves as an etch mask for the underlying substrate, transferring the pattern to the

substrate by means of any suitable dry etching process such as reactive ion etching (column 3, lines 18-23). The aforementioned, reads on,

selecting a workpiece with a hard mask deposited over a layer to be etched, which hard mask is comprised of a reactive metal, the hard mask further defining a pattern including at least one portion having a critical dimension; and

processing the workpiece in a reactor by exposing the entire hard mask to an etch.

Since Nulman uses the same method and same process gas in oxidizing the same material (Al film), which result in forming an oxide on the surface of the mask as disclosed in applicant's Specification (page 10, lines 14-18), then using Nulman method reads on, allowing the hard mask to react with etch process gases and would inherently oxidize the hard mask in order to harden the hard mask.

Nulman differs in failing to explicitly teach whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of the layer during the etch is minimized in the portion of the layer corresponding to the critical dimension, as in **claim 51**.

Since Nulman uses the same method and gases in processing a substrate (workpiece) in a reactor as that of the claimed invention, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention that by using Nulman's method would result whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of layer is minimized in the portion of the layer corresponding to the critical dimension, as in the claimed invention.

Nulman teaches oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14** (column 5; lines 3-5), in which the surface layer of Al_2O_3 is assumed to be the same as applicant's skin that is formed on the hard mask. Hence, the aforementioned reads on allowing the hard mask to react with etch process gases forms a skin on the hard mask, in **claim 52**.

7. Claims 53-56 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Nulman ('419).

As pertaining to claim **53**, Nulman teaches a method for etching a pattern on a workpiece. The method comprises: covering a substrate (workpiece) **12** with an aluminum film **14,** oxidation mask **16,** and resist **18** (column 4, lines 8-13, 21-22); oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14** (column 5, lines 3-4); and when the Al (same as applicant's hard mask) film serves as an etch mask for the underlying substrate, transferring the pattern to the substrate by means of any suitable dry etching process such as reactive ion etching (column 3, lines 18-23), which reads on,

processing the workpiece using process gases, the workpiece having a hard mask deposited over a layer to be etched, which hard mask is comprised of a reactive metal and defines a pattern.

Nulman teaches oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14** (column 5; lines 3-5), which reads on allowing the hard mask to react with the etch process gases. Since Nulman uses the same method and same process gas in reacting the same material (Al film), then using Nulman's method would inherently harden the hard mask.

Nulman differs in failing to explicitly teach whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of the layer during the etch is minimized in the portion of the layer corresponding to the critical dimension, as in **claim 53**.

Since Nulman uses the same method and gases in processing a substrate (workpiece) in a reactor as that of the claimed invention, then it would be obvious to one having ordinary skill in the art at the time of the claimed invention that by using Nulman's method which is the same as that of the claimed invention, would result whereby the layer is etched corresponding to the pattern of the hard mask, and the growth of the layer is minimized in the portion of the hard mask layer corresponding to the critical dimension, as in the claimed invention.

Nulman teaches oxidizing the surface of aluminum film **14** by O_2 plasma (column 3, lines 1-5) produces surface layers of aluminum oxide (mainly Al_2O_3) on the exposed surface portions of film **14,** as indicated at **30** (column 5; lines 3-5). Since Nulman's method of oxidizing the Al film results in forming Al_2O_3 on the hard mask surface and assuming the Al_2O_3 is the same as the skin on the hard mask, then using Nulman's

method reads on allowing the hard mask to react with etch process gases forms a skin on the hard mask and would inherently result in a skin on the hard mask being harder than the hard mask, in **claim 55**; and reads on selecting a hard mask that will react with the etch process gases and would inherently result in order to hard the hard mask, in **claim 56**.

Nulman teaches dry etching of the Al metal layer **14** results in a pattern mask **32** because of the large etch ratio between plasma oxidized and nonoxidized aluminum (column 5, lines 21-28) and this large etching ratio permits fabrication of the meal film pattern mask **32** (column 5, lines 53-54), which reads on,

The hard mask further defines a pattern including at least one portion having a critical dimension.

Nulman further teaches; finally, the Al mask may be removed, leaving the fine lines **36** (critical dimension) in a pattern, which is the inverse of the initial pattern in FIG. **3** (column 6, lines 8-11), which reads on,

wherein the growth of the layer during the etch is minimized in the portion of the layer corresponding to the critical dimension, in **claim 54**.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable reached on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-972-9310 for regular communications and 703-972-9311 for After Final communications.

BENJAMIN L. UTECH
SUPERVISORY PATENT EXAMINER
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November 20, 2002